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**DEPARTMENT OF ECONOMICS
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**The Pastoral Boom, the Rural Land Market, and Long Swings
in New Zealand Economic Growth 1873-1939**

by David Greasley and Les Oxley

WORKING PAPER

No. 02/2008

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The Pastoral Boom, the Rural Land Market, and Long Swings in New Zealand Economic Growth 1873-1939

by David Greasley¹ and Les Oxley^{2†}

February 2008

Abstract: A pastoral boom led to higher farm and manufacturing productivity and to New Zealand attaining the world's highest HDI in 1913. Staple exports invigorated the land market, diffused rural land ownership, and fostered intensive growth. The gains from higher land prices spread widely, but land market volatility also created instability. New Zealand had the world's highest GDP per capita in 1938, but she experienced long swings in her growth rates. Dramatic swings in rural land market activity engendered by the pastoral boom contributed powerfully to a long depression in the 1920s; subsequently a new monetary regime facilitated fast recovery.

Keywords: Land ownership; pastoral sector; manufacturing productivity; New Zealand land prices

JEL Classifications: N17, N37, N47

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Whether or not staple exports provide a route to prosperity has been keenly contested by historians and development economists. Here we add the case of New Zealand's refrigeration-related pastoral export boom to the debate, and consider the implications for both intensive growth and economic instability. Much of the wider debate evolved from discussions of Canadian economic development stimulated by Innis and Macintosh.¹ Chambers and Gordon modelled staple-led growth by postulating that prairie land rents in the case of Canada's wheat boom can be used to measure the consequences for per capita income, but they denied the importance of staple exports for intensive growth.² Others, including Altman, Caves, Green and Sparks, and Schedvin contend that economy-wide productivity was augmented by Canada's wheat boom, and these analysts argue that higher labour utilization, immigration-linked scale economies, and induced technological progress promoted intensive growth; effects which are not captured by Chambers and Gordon's model.³

Another strand of the staple export-led growth debate highlights inimical connections with income inequality. Baldwin for example argued that cotton states in the USA were caught in a 'staple trap' associated with uneven income distribution.⁴ More recent analyses, including those of Huff and Williamson have shown that the late nineteenth and early twentieth century staple export booms deterred industrialization, and set in motion powerful forces of inequality in the natural resource abundant economies of the periphery, by depressing wages relative to land rents, which were barriers to economic development.⁵ Apart from those elements of the Canadian historiography which argue that staple exports augmented economy-wide productivity, the staple export-led growth hypothesis has not fared well over recent decades. New Zealand has been largely excluded from the modern debates, although Schedvin argued that she became caught in

a ‘staple trap’.⁶ His interpretation lays stress on the post-1945 growth record of New Zealand when insular protectionist policies influenced her economic structure and efficiency.

Our case study of New Zealand for years to 1939 casts the staple export-led intensive growth hypothesis in more favourable light, although the Dominion’s heightened prosperity was accompanied by instability. In particular, we show that the effects of New Zealand’s post-1890 refrigeration-related pastoral export boom strongly raised both farming and manufacturing productivity. Patterns of land ownership were transformed, with the consequence that the higher rental incomes generated by staple exports spread widely. New Zealand’s land market, though, was volatile, and the social depth of land ownership engendered by the export of refrigerated staples meant that land market instability was translated into wider macroeconomic instability. The form of staple exports promoted by refrigeration was important in raising economy-wide productivity. When staple exports were dominated by wool in the years to 1890 New Zealand’s intensive growth prospects appeared less strong.

I

Prior to the refrigeration era New Zealand’s economic activity focused on the South Island and on the export of wool from the great estates using farming methods that needed relatively little labour. Average incomes per capita in the Dominion around 1870 were high compared to the rest of the world, but falling and the prospects for economic development appeared uncertain.⁷ Immigration was encouraged in the 1870s by a policy of assisting passage, and by public works – notably railway building.⁸ Yet by the end of the 1880s New Zealand experienced net emigration, urban unemployment, discontent surrounding sweated conditions in the clothing trades, and an unrequited hunger for land among the settlers. Much of New Zealand’s historiography for the years from 1890 highlights the role of refrigeration-related pastoral

exports in transforming her economic prospects, which led, for example, to the Dominion attaining living standards measured by the HDI that ranked first in the world in 1913.⁹

In New Zealand, the opportunities of refrigeration led to a distinctive staple export boom, of dairy and meat products, which increased the cultivated area and the size of the Dominion's economy.¹⁰ Our objectives are to gauge how much intensive growth was also promoted by New Zealand's pastoral export boom, and to consider whether or not the boom created instability. There are several possible reasons why refrigeration-related pastoral exports raised incomes per capita. Dairying or mixed farming led to more intensive land use, and to higher farm productivity. Moreover, the shifts in farm production away from wool to dairy and meat were accompanied by organizational moves to smaller farms and wider-spread land ownership, which set New Zealand apart from, for example Uruguay and the Argentine, and more even income and wealth distribution stimulated a broadly-based enterprising economy in the Dominion.¹¹ Finally, dairy production and meat freezing involved substantial off-farm processing, and in the case of butter and cheese this was associated with large-scale co-operative factories, which raised manufacturing and distribution productivity. However, the pastoral export boom also heightened the volatility of the rural land market. A distinctive characteristic of New Zealand was the extent that the optimism generated by the refrigeration-related pastoral boom was capitalized into higher land prices in the years to 1920. Subsequent fluctuations in rural wealth may have translated into wider economic instability, most especially during the 1920s when land transactions and prices fell.

In 1938 New Zealand's GDP per capita, adjusted for purchasing power parity, was the highest in the world, but the Dominion's development was accompanied by long swings in economic growth.¹² Real GDP per capita fell in the years to 1890, when wool dominated staple

exports. Thereafter, in the forty years 1890-1938 New Zealand's real GDP per capita growth averaged around 1.26 per cent per annum, but there were marked swings around the mean growth rate, which are shown in Table 1.¹³ In particular, New Zealand experienced a thirty-year boom from around 1890, a long depression centred on the 1920s, and a remarkably fast recovery during the 1930s. Accordingly, the Dominion's GDP per capita, corrected for purchasing power differences, was 97.2 per cent of the US level in 1913, but this relativity fell to 76.3 per cent in 1929 and rose to 105.5 per cent in 1938.¹⁴

Table 1: New Zealand's real GDP per capita (% per annum)					
1873/5- 1889/91	1889/91- 1911/13	1911/13- 1927/29	1927/29- 1937/39	1889/91- 1937/9	1873/5- 1937/9
-0.47	1.49	-0.18	3.09	1.26	0.83
Sources: Greasley and Oxley, 'Measuring New Zealand's GDP', and 'Regime shift.					

Technological changes promoting dairy product and frozen meat exports from New Zealand transformed the farming landscape, patterns of land ownership, and the organization of manufacturing in the Dominion. Four strands of evidence are used to address our two key objectives, and to gauge the connections between refrigeration-related pastoral exports, and both the prosperity and the instability of New Zealand's economy. These are the growth of farm productivity; rural land rental values compared to GDP per capita; the size and the productivity of the manufacturing sector; and the relationship between GDP per capita and the forces causing its long swings, using a modern time series approach.

II

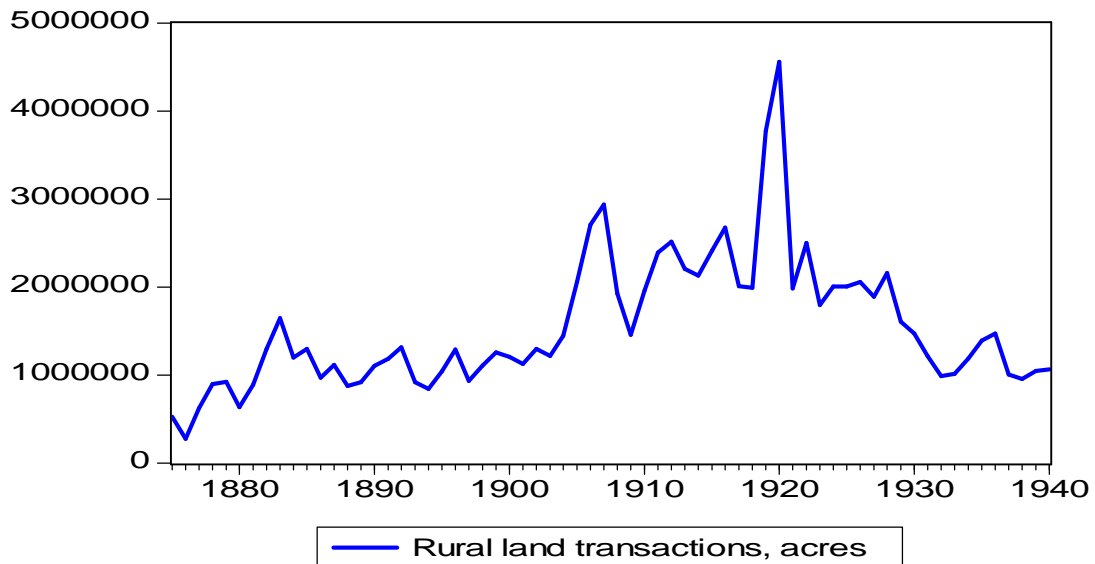
Farm staple export booms typically extend margins of cultivation, but New Zealand's went much deeper. The rise of dairying and meat farming invigorated the rural land market, created closer settlement, and led to more intensive land use and higher farm productivity. Before 1890 there were strong barriers to closer settlement, connected in the South Island to the extensive wool-sheep holdings of alleged land monopolists, and in the North Island to the less penetrable landscape and the hostile Maori. Land policy, and debate surrounding how to promote more intensive settlement, dominated New Zealand's political economy during the 1880s.¹⁵ Expansion northwards of the farm frontier during the refrigeration era after 1890, supported by the subdivision of estates in the south, broke the land congestion.

Land monopoly was associated in New Zealand with estates in excess of 10,000 acres, but these accounted for only 3.5 million acres of occupied land in 1910, compared to 7.8 million acres in 1892.¹⁶ One contemporary analyst noted that New Zealand might have developed on the South American model, characterized by extensive pastoral farming closely connected to the large-scale industrial processing of foodstuffs.¹⁷ Yet by 1920 small and medium farms dominated, with 44.1 per cent of holdings being in the 100-1000 acre range.¹⁸ Public policies, including a graduated land tax and compulsory repurchases, were directed towards dismantling the great estates, and they reinforced the effects of the dairy and meat export boom in promoting closer settlement. The mean size of non-Crown pastoral lease farms fell from 489 to 353 acres between 1881 and 1906, although there was regional variation.¹⁹ Dairy farms, for example, were smaller, with a mean of 162 acres in 1925.²⁰ The moves to closer settlement had important implications for rural land market activity and farm productivity.²¹

Selling land was cheap and simple in New Zealand after the Torrens system of land registration was adopted in 1870.²² Registration at a land office provided secure title at low cost, which diminished barriers to the frequent transfer of rural land. Rural land transfers reached 1 million acres in 1895, and gathered pace to peak at 4.5 million acres in 1920. Around 28.4 million acres of rural land transferred ownership 1910-20, equal to around 70 per cent of occupied land in 1920. There were around 77,000 registered rural land transactions 1915-1921, a time when New Zealand had 135,000 farmers and an occupied population of around 0.5 million.²³ Much of the latter activity was associated with land sales to returning soldiers, funded by the government, which provided £22.6 million to 22,500 new land buyers in the already inflated land market of 1919-20.²⁴ Land transactions did not regain 1920 levels until after World War II, see Figure 1 below.

New Zealand's invigorated land market was accompanied by a rise in the cultivated area (chiefly sown grasses) which rose from 8 million acres in 1890 to 18 million in 1920, and to 19.7 million acres in 1939.²⁵ The cultivated area does not equate identically to occupied land or farmland in New Zealand since pastoral farming was also undertaken on native grassland, especially on the high country wool farms of the South Island. However, the extension of the cultivated area was central to the rise of refrigeration-related dairy and meat farming productivity. More intensive farming methods utilizing better quality sown grasses increased the numbers of animals per acre, and raised the yields from individual animals.²⁶ By 1939 there were 31.3 million sheep and 4.6 million cattle in New Zealand, and 1.6 million people.

Figure 1



Source: Summaries of transactions are reported each year in *Appendices to the journals of the house of representatives*, section H.

New Zealand's refrigeration-related pastoral boom heightened farm productivity. Central to the productivity rise was the increased capacity of the land to support animals. The consequences were most dramatic in the case of cattle, where the number of animals per cultivated acre doubled over the years of the pastoral boom, see Table 2. Additionally, cheese and butter production per dairy cow rose, from 0.33 hundredweights per animal in 1895, to 2.17 in 1921 and 2.89 in 1929.²⁷ The sheep flock increased less quickly, and its size fell relative to the human population, but the flock's growth exceeded that of occupied land. The composition of the sheep

flock also shifted, away from breeds most prized for their wool to those valued for their meat, which realized the higher financial returns for farmers during the refrigeration era.²⁸

Table 2: Sheep and cattle per acre and per capita				
	Sheep per 100 acres#	Sheep per capita	Cattle per 100 acres*	Cattle per capita
1891	56.8	28.7	9.9	1.3
1911	68.5	23.7	12.5	2.0
1921	53.4	19.0	17.2	2.6
1929	66.7	19.8	18.2	2.3
1939	74.6	19.7	23.3	2.8
# occupied and includes lambs *cultivated and includes dairy cows. Sources: same as for footnote 28.				

III

During technologically created staple export booms Chambers and Gordon postulate that labour and other resources are attracted to the new export sector without affecting factor returns elsewhere in the economy, that new settlement occurs, and that the farm frontier extends until rents at the margin of cultivation returns to zero. The rise in rent shows, for Chambers and Gordon, the intensive growth effects of the Canadian wheat boom. New Zealand's experience does not accord well with the assumptions of Chambers and Gordon's model, since economy-wide productivity was influenced by the economic transformations associated with the refrigeration-related staple boom.

New Zealand's dairy and meat export boom had powerful effects on land values, and thus on GDP per capita, but the implied rise in rental values for cultivated land should not to be interpreted within the context of Chambers and Gordon's model. To an extent both the investment needed to create cultivated grass land, and the work of family farmers was capitalized

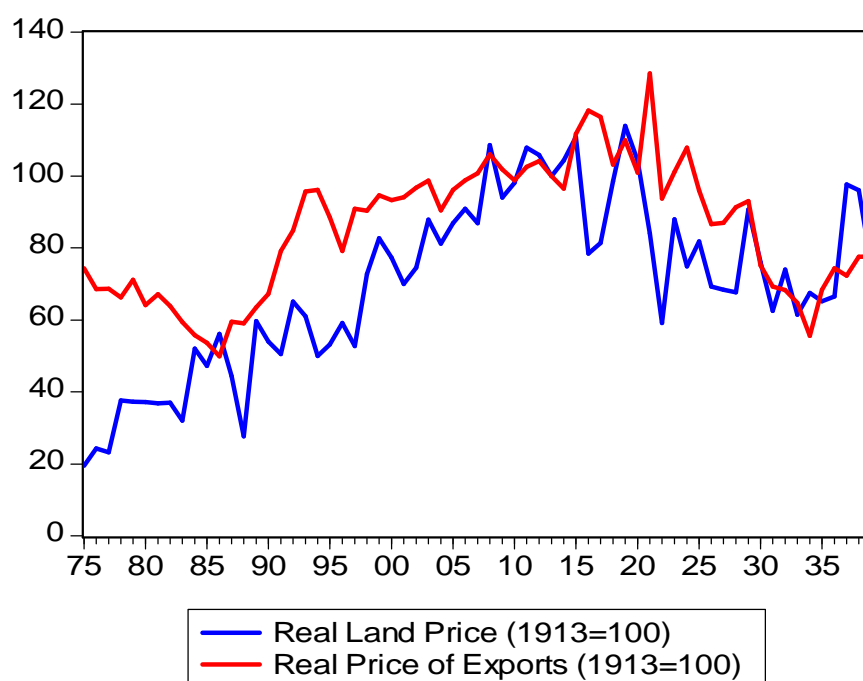
into higher land prices. It is also likely that higher productivity in the processing of milk and meat in factories influenced land values, and thus of rent estimated by de-capitalizing land values. Chambers and Gordon's theoretical model incorporates a much narrower concept of economic rent, defined to gauge the effects, on certain assumptions, of simply extending the margin of cultivation. In the New Zealand context, the consequences of the refrigeration-related pastoral boom went much deeper, to impinge on economy-wide productivity. Land rental values provide evidence for gauging the wider consequences of New Zealand's refrigeration-related pastoral boom. However, care needs to be taken when interpreting the implications of our estimates of the rise in New Zealand land rents, which differ from the concept used by Chambers and Gordon.

There have been several attempts to measure New Zealand land prices for years prior to 1939 and new data are reported here as Figure 2.²⁹ These data are partially based upon the land transfer records of the Dominion's registration system, which provide an important source of price information, given the frequency with which rural land changed hands.³⁰ Variations in the quality of land sold each year typically hinder the construction of land price series. For New Zealand, however, the rural land market was highly active, and average transfer prices are based on substantial information. Callaghan though, measured Canterbury land prices for the years 1870-1914 using other sources, including the lease register for Canterbury College lands, and these data are used for the years to 1915 when the land registry data conflates the values (but not the volumes) of urban and rural transfers.

In 1915, the first year that country and town values are distinguished in the Land Registrar's reports, country prices averaged £7.40 per acre and town land £473.18 per acre, while overall transfers averaged £9.20 per acre. Country land price levels, however, do not equate to

prices of the cultivated land which underpinned the growth of dairy and meat exports. In 1891 only 8.4 million acres of the 31.9 million acres occupied in New Zealand was cultivated. Concomitant with the staple-export boom was a rise in the cultivated area to 18.1 million acres by 1921. Average land prices though, given the volume of market activity, should reasonably reflect price movements, including of cultivated land. These data show that New Zealand experienced a long real land price boom to 1919 followed by deflation until the mid-1930s, see Figure 2. In real terms, land prices rose by around four times 1890-1913, but they fell by around 40 per cent during the long depression of the 1920s.

Figure 2



Sources: Land prices, Greasley and Oxley, 'Refrigeration and distribution'. Export prices, Bloomfield, *New Zealand handbook*. The price deflator is from Nesbit-Savage, 'A long run'.

Gauging the rise in rents, measured here by de-capitalized land values, associated with the staple boom requires that its start year is defined. New Zealand's dairy exports were modest prior to 1890, partly because of technological and shipping capacity barriers. Frozen meat was first shipped from New Zealand in 1882, and meat export values initially led those of dairy products. However, the rural land market remained fragile during the 1880s, especially during the banking difficulties of 1888. Export prices, see Figure 2, as well as land prices began their long upswing in the early 1890s; and using 1890 as the start date for the refrigeration-related pastoral boom is appropriate, and avoids the possible bias of unusually depressed land prices in earlier years.

The price of cultivated land was substantially higher than the average price of country land, which includes great areas of upland grazing. One approach to measuring the price of cultivated land (which in New Zealand principally comprised sown grasses) involves using the occasional data available for dairy farms. Following the boom surrounding World War One dairy land prices in New Zealand stabilized at around £46.3 per acre in 1925.³¹ The estimates of average land prices in Figure 2 are used to project this benchmark price to the years shown in Table 3. The land price data in conjunction with the estimates of the cultivated area show how the nominal value of cultivated land rose in the Dominion during the pastoral boom years.³² Rental values, as measured by cultivated land values de-capitalized by the mortgage rate, are also shown.³³

Table 3: Gauging the pastoral boom's effect on New Zealand's GDP per capita					
	Cultivated Land Value (£ million)	Cultivated Area (million acres)	Rental Values per capita (£)	Land Value per acre (£)	Nominal GDP per capita (£)
1890	129.92	8.0	11.75	16.24	43.09
1914	618.28	16.4	32.54	37.77	72.49
1919	1072.36	17.4	54.07	61.63	144.13
1929	969.76	19.0	39.59	51.04	110.91
Sources: For national income, Greasley and Oxley, 'Measuring New Zealand's GDP'. The construction of the other data is described in the text.					

New Zealand's real GDP per capita rose by around 1.5 per cent per year 1890-1914. Over the same period the estimated nominal rental value of New Zealand's cultivated land relative to her population rose by £20.8 and her nominal GDP per capita by £29.4. Thus around 70 per cent of the rise in aggregate income per capita is associated the rise in cultivated land rentals during the key years of the refrigeration-related pastoral boom. This finding accords well with estimates which shows a low real wage growth in New Zealand of 0.33 per cent per annum for the years 1890-1913, which equates to only around 25 per cent of the real GDP per capita growth rate.³⁴

While land rents were the dominant force behind aggregate income per capita growth during the years of the refrigeration-related pastoral boom, it should be remembered that our measure of rent encapsulates a variety of possible forces related to staple exports, including elements of investment and work that were capitalized in higher land prices. The results though show how profoundly the post-1890 staple export boom influenced New Zealand's income per capita by transforming the farming economy, which was reflected in the rise in the value of cultivated land. Subsequently, the decline in rental values during the 1920s was associated with a fall in GDP per capita. We will return to the issue of instability later, following a more detailed look at the implications of refrigeration-related pastoral boom for the manufacturing sector.

IV

New Zealand's pastoral export boom did not crowd out manufacturing employment, which changed little from 19.4 per cent of overall employment in 1890, to 19.7 per cent in 1910, and 20.7 per cent in 1925.³⁵ Further, there was a marked rise in the share of manufacturing employment that was in factories, much of it connected to processing refrigerated products. Hawke estimated the relative shifts of factory and handicraft employment in New Zealand.³⁶ He reported that 'industrial', namely factory employment rose from 10.2 per cent to 13.3 per cent of overall employment 1890-1925. The fastest growth of factory employment over these years was for primary product processing. Meat freezing and dairy products combined accounted for 11.6 per cent of factory employment in 1938, compared to 7.2 per cent in 1890.

Factories are defined in the Dominion's statistics to include manufacturing establishments employing at least two workers, but various crafts, including bakeries, butchers, and smithies were explicitly excluded from the returns.³⁷ The censuses, and subsequently the annual statistical reports of factory production, show gross production values, and sometimes the cost of materials used, in addition to employment, and provide a basis for measuring manufacturing productivity. Overall, factories employed 25.6 thousand in 1890, with a gross output of £8.8 million, or £343.8 per head. By 1938 gross factory output per worker had risen to £629.3, in 1890 prices, and employment to 102.5 thousand.³⁸ Manufacturing labor productivity 1890-1938 thus rose by 1.27 per cent per annum, to match near exactly real GDP per capita growth in the Dominion.

Our particular concern lies with estimating manufacturing productivity for meat freezing and dairy products, to gauge the productivity spill over of the pastoral boom. Together, these

sectors accounted for around 12 per cent of factory employment in 1938, while they accounted for 42 per cent of gross manufacturing output, and 16 per cent manufacturing value added in the same year. The increased importance of dairy factories and of freezing works heightened the size and the scale of factory production in New Zealand, and led to higher productivity, see Table 4.

Table 4: Output and employment in dairy and meat-freezing factories				
Meat Freezing				
	Gross output (£million)	Value added (£million)	Labour	Output/Labor (£ 1890)*
1890	1.5	n.a.	1568	956.6
1928	15.3	3.0	6139	1335.7
1938	20.7	3.8	7897	1481.6
Butter and Cheese				
	Gross output (£million)	Value added (£million)	Labour	Output/Labor (£ 1890)*
1890	0.15	0.05	271	553.5
1928	21.9	3.5	4167	2807.8
1938	27.3	2.4	3944	3904.7
Notes: * based on gross output converted to 1890 prices, n.a. not available.				
Sources: <i>New Zealand census</i> 1891, <i>Statistical report of factory</i> , 1929 and 1939.				

In 1890 the Dominion had 43 meat freezing factories, but only 38 in 1938, while employment rose by around 5 times and real gross output by around 14 times over the same period. For meat freezing gross output per worker in 1890 prices grew by 0.92 per cent per annum 1890-1938, a productivity growth rate below the economy-wide average. In part, the relatively slow productivity growth may have been due to an aging of the capital stock, most freezing works in use in 1938 were built before World War I, and no new works were constructed after 1922. However, the value added by meat freezing works rose more quickly than gross output, as an increasing variety of products, including pelts, skins, wool, and fertilizers, were marketed.³⁹ The ratio of value added to gross output in freezing factories was 18.3 per cent in 1938, compared to 10.9 per cent in 1910. Value added is not known for earlier years, but if its

1910 ratio to gross output is assumed for 1890, real value added per worker 1890-1938 rose by 2.01 per cent per annum, comfortably above the economy-wide average.

New Zealand dairy factories were generally constructed later than the freezing works and became dominated by co-operative enterprises. Of the 429 dairy factories operating in 1938 95 per cent were co-operatives.⁴⁰ In 1890 the Dominion's 74 dairy factories average gross output was £2027, which increased, in 1890 prices, to £35,897 by 1938. Co-operative dairy factories were thus smaller than the corporate freezing works, and in 1938 the value of buildings, machinery, and land per dairy factory was £8391 compared to £142,000 for the freezing works.⁴¹ Co-operative dairy factories in New Zealand, though, were large by international standards, and averaged, for example, three to four times the output volumes of Wisconsin creameries and cheese factories by the 1920s.⁴²

Russell and Macklin also show scale economies were realized in New Zealand dairy factories; they estimate butter production costs ranged from 3.9-7.7 cents per pound, depending on plant size, and they emphasized the degree of factory rationalization within the Dominion compared to Wisconsin.⁴³ Average dairy factory output volumes in the Dominion were 760,928 pounds in 1928, compared to 85,904 in 1890.⁴⁴ The largest New Zealand factories in the Waikato region produced around 6 million pounds of butter annually in the mid-1920s, whereas at Barron, Wisconsin, the largest plant in the USA, capacity was around 2.5 million pounds.⁴⁵ Gross output per worker in New Zealand dairy factories in 1890 prices rose from £553.5 in 1890 to £3904.7 in 1938, an average of 4.2 per cent per annum, although valued added per worker grew less quickly.

The New Zealand system of dairy mass production integrated farm and factory operations. Most importantly, the process of cream separation shifted to a large extent from the factory to the farm. Home-based cream separation reduced transport costs, especially in the areas

where wheeled transport was difficult. The challenge for the factories was to ensure the quality of their farm-produced supplies. As on-farm cream separation grew after 1905, so did the testing of the supplies to the factories, and tests became compulsory in 1914.⁴⁶ By 1935 95 per cent of cream separation took place on the farms, and the higher value of the materials supplied to the factories partly explains why their value added grew less quickly than gross output.⁴⁷ Additionally, co-operative dairy factories paid relatively high prices to farmers for milk and cream during the 1930s, and the ratio of factory value added to gross output fell from 16.9 per cent in 1928 to 8.8 per cent in 1938. Even so, real value added per dairy factory worker 1890-1938 grew by 1.31 per cent per annum, although real value added labor productivity growth 1890-1928 at 2.36 per cent per annum was higher.

During the pastoral boom higher productivity spilled from the farm to the factory. Since New Zealand dairy farmers by the 1920s also received 81 per cent of the London wholesale price of butter, transport and distribution was also carried out efficiently.⁴⁸ In some respects distinguishing between the farm and the factory is invidious under New Zealand's system of mass producing dairy products. Heightened dairy production was made possible by smaller farms and the (year round) cultivation of grass, but also by machine-milking, and the on-farm centrifugal separation of cream. Machine-milking forged ahead more quickly in New Zealand than in the USA, and was quickly incorporated with the direct transfer of milk to the receiving tanks of farm-based machine-powered cream separators.⁴⁹ The large co-operative dairy factories were supplied by their farmer-owners, and mass produced standardized high quality butter and cheese.⁵⁰

Any estimate of the contribution made by higher productivity in dairy and meat freezing factories to New Zealand's real GDP per capita needs assumptions about the course

manufacturing productivity would have taken in the absence of the pastoral boom. For the period 1890-1928 we have estimated real value added per worker in dairy and meat freezing factories at 2.36 and 2.01 per cent per annum respectively. Manufacturing generally experienced productivity growth of around 1.27 per cent per annum, to match near exactly the Dominion's real GDP per growth 1890-1938 of 1.26 per cent per annum. Since employment in dairy and meat factories was around 12 per cent of factory employment in 1928, other factories productivity growth averaged roughly 1.0 per cent per annum. If all manufacturing had averaged a 1.0 per cent per annum productivity growth, rather than being augmented by higher pastoral product processing productivity, and manufacturing share of total employment had remained around 20 per cent, New Zealand's real GDP per capita growth rate 1890-1938 would have been reduced by around 5.0 per cent.

This modest estimated manufacturing productivity-increasing effect of the pastoral boom stems from the relatively low employment within dairy and meat factories, and the narrow productivity growth differential between manufacturing and the wider economy. The results, though, show that New Zealand's staple export boom raised factor returns in manufacturing, and increased the size of the factory sector in New Zealand. It is likely that productivity in transport and distribution was also raised by the pastoral boom. Nevertheless, the principal returns from staple exports took the form of higher returns for landowners. These were considerable, and had powerful income and wealth distribution effects within New Zealand.⁵¹ The rise in the social depth of land ownership stimulated in the Dominion by the pastoral boom meant that the gains from rising land prices to 1920 spread widely. Next we consider the implications for economic instability.

A staple export boom, by raising farming and manufacturing productivity, underpinned New Zealand's internationally high GDP per capita in the years to World War II. Now we consider how the pastoral boom drove the long swings in the Dominion's economic growth and, in particular, contributed to the long depression of the 1920s. Most analyses of instability among primary producers emphasize the de-stabilizing role of exogenous export price shocks.⁵² Much of New Zealand's historiography highlights the importance of the terms of trade for the contours of the Dominion's prosperity.⁵³ The perspective offered here differs, and lays more stress on the endogenous forces set in motion by the pastoral boom, connected to rural land market volatility and farm productivity, in shaping the long swings in New Zealand economic growth.

There are several possible, inter-twined links between the volatility of the rural land markets and the long swings in New Zealand economic growth. Contemporaries blamed 'land-trafficking' for over-inflating the land market and causing the long depression around the 1920s.⁵⁴ Land market volatility directly influenced the net wealth of the rural economy, and shifts in the land owners' prosperity transmitted to the wider economy via their spending.⁵⁵ The economic fortunes of a substantial proportion of New Zealanders, around 28 per cent of the occupied population were farmers and 44 per cent of the population lived in rural areas in 1921, were directly tied to the vagaries of the rural land market. The contention investigated here is that the source of New Zealand's prolonged 1920s depression principally resided in the volatility of her rural land market.

The terms of trade had unusually powerful effects on the land rental-wage ratio in New Zealand, with a magnification factor of around two.⁵⁶ Thus, the Dominion's farmers' productivity advantages tended to be capitalized in the form of higher land values. Land prices

directly influenced farmers' income since their financial success was often linked to the frequent sales of land. In 1920 there were 84,706 farm holdings in New Zealand, compared to 43,777 in 1890, but in 1915-21 alone there were around 77, 000 rural land transfers. The higher prices paid for land after 1890 were easily recouped by re-sale before 1920. One contemporary analyst postulated that the easy profits from selling land tempered farmers' productive efforts.⁵⁷ Any strategy by small and medium size farmers of relying on land sales as a form of income was undermined by the fall in land prices after 1920. Additionally, net new mortgage commitments rose sharply to 1920, leaving the new borrowers with heavy real debts when prices fell.⁵⁸

Post World War I rural optimism in New Zealand resembled that observed by Johnson for the USA, although the deleterious consequences of its collapse in the Dominion were accentuated by the greater importance of farming there.⁵⁹ Indeed, Russell and Macklin argue that speculation in dairy land in New Zealand was very much worse than in Wisconsin, and even went further than in the US corn-belt.⁶⁰ They estimated for 1925 that dairy land values in Wisconsin were two-thirds of the New Zealand level, and that land value interest was 37.5 per cent of total dairying costs in New Zealand, but only 22.2 per cent in Wisconsin. The Dominion capitalized its efficiency advantages into higher land values, which did not realize returns to the farmer unless the land was re-sold at a higher price.

There are many citations to debt-ridden farmers walking off their lands, and in 1927 New Zealand experienced the highest outflows of migrants since the pre-pastoral boom decade of the 1880s.⁶¹ However, land under cultivation rose slightly in the 1920s, and Hussey and Philpott estimate that farm output volumes rose by 33 per cent 1921-29.⁶² Farmers during the 1920s generally kept producing, and in greater quantities, but their spending was constrained by a

reduction in their net wealth and by their inability to sustain their accustomed route to financial success, selling land.

The troubles of the farmers had potentially damaging implications for other sectors of the economy, which were not offset by distributional changes in the 1920s which benefited non-farm incomes. The wage-rental increased, but urban wage earners gained little as real wages in the Dominion stagnated along with real GDP per capita in the 1920s.⁶³ If the land market collapse depressed New Zealand's real GDP per capita through the long depression of the 1920s, it also depressed real wages, and the troubles of the farm sector spilled to the urban economy.⁶⁴

In combination, land market volatility, wider spread land ownership, and higher farm productivity possibly set in motion powerful forces which drove the long swings in New Zealand's GDP per capita, including the long depression of the 1920s. However, the role of export prices and the possibility that the 1920s downswing was exacerbated by monetary deflation spilling from Australia via a common trans-Tasman banking system are also considered in the time series model estimated in the following sub-section. Certainly deflation hit heavily indebted farmers hard after 1920, and consequentially New Zealand's escape from the long depression needed a new inflationary monetary regime, which raised relative farm prices.⁶⁵

VI

The relationships between New Zealand's real GDP per capita, farm productivity, land market volatility, and other variables, including export prices and monetary conditions are investigated within a vector error correction model (VECM). Normalized on real GDP per capita the model includes the volume and the real price of land transactions, farm productivity measured by cattle and sheep per capita, income distribution measured by the wage-rental ratio, the real price of

exports, a currency-based monetary aggregate, land in cultivation, and real public works spending. The unit root tests reported in Table 5 show that the null of non-stationarity is not rejected at conventional significance levels for any of the variables.

Table 5: Unit root tests (log levels): 1874-1939
Adjusted Dickey-Fuller (ADF)

Variable	ADF¹
Real GDP per capita ²	-2.54
Real price of land	-3.07
Nominal wage/Nominal land price	-2.84
Real price of exports	-2.43
Cultivated land area per capita	-2.66
Real notes and coins per capita	-0.39
Cattle per capita	-3.00
Sheep per capita	-2.82
Rural land transfers per capita	-2.43
Real public works expenditure per capita	-3.24

¹ Degree of augmentation in ADF determined by Akaike Information Criteria. ² Includes Maori in population.

Sources: For notes and coins, Sheppard, Guerrin and Lee, 'New Zealand monetary aggregates', for public works spending, Bloomfield, *New Zealand handbook*, and for price deflator, Nesbitt Savage, 'A Long Run'. Otherwise see the text.

A cointegrating relationship exists between all the candidate variables other than cultivated area per capita, see Table 6. The statistical results show that long swings in New Zealand's economic growth were driven by farm productivity, land market volatility, export prices, monetary conditions, income distribution, and public spending. The absence of a discrete role for shifts in the cultivated area is puzzling, but may have been caused by the inclusion of direct productivity measures in the model. Land in cultivation, principally sown grasses, certainly influenced farm productivity. Farm productivity itself, measured by cattle and sheep per capita did move with real GDP and the other significant variables in the cointegrating relationship.

Table 6
Johansen-based cointegration results: log real GDP per capita, 1875-1939
 (VAR=1, Linear deterministic trend)

H ₀	H ₁	Max eigen	Variable (Log)	Long run coefficient
r=0	r=1	91.62*	Constant	-15.10
r≤1	r=2	68.27*	Rural land transfers per capita	0.34*
r≤2	r=3	44.33	Real export price	0.43*
r≤3	r=4	37.19	Cattle per capita	0.79*
r≤4	r=5	23.33	Nominal wage /Nominal land price	1.05*
r≤5	r=6	21.92	Real land price	0.62*
r≤6	r=7	7.752	Real coins and notes per capita	0.29*
r≤7	r=8	5.227	Sheep per capita	0.64*
r≤8	r=9	1.755	Real public works per capita	0.08*

Denotes significant at the 5 per cent level, and VAR denotes vector auto regression.
 Sources: Johansen, 'Structural analysis', otherwise as for Table 5.

The particular concern here is to make use of the estimated cointegrating relationships to understand the forces shaping New Zealand's long depression of the 1920s. On the basis of endpoint estimates, real GDP per capita growth averaged -0.18 per cent per annum over the years 1911/13-27/28, and the chief negative influences, see Table 7, were the declines in rural land transfers, export prices, land prices, sheep per capita, and money. The long run coefficients were estimated within a multivariate framework, but they offer a guide to the force of the various adverse influences on real GDP per capita during the long depression. Ostensibly, the land market related variables, the volume and the price of land transfers, had the most substantial adverse effects, but care needs to be taken when interpreting the role of land prices.

In the long run increases in the wage-rental ratio are associated with higher real GDP per capita. The rise in the wage-rental ratio was thus a positive growth influence in the 1920s, whose net effect was diminished by the offsetting effects of lower land prices. On balance, therefore, relative factor prices shifts did not exert an especially powerful force on falling GDP per capita

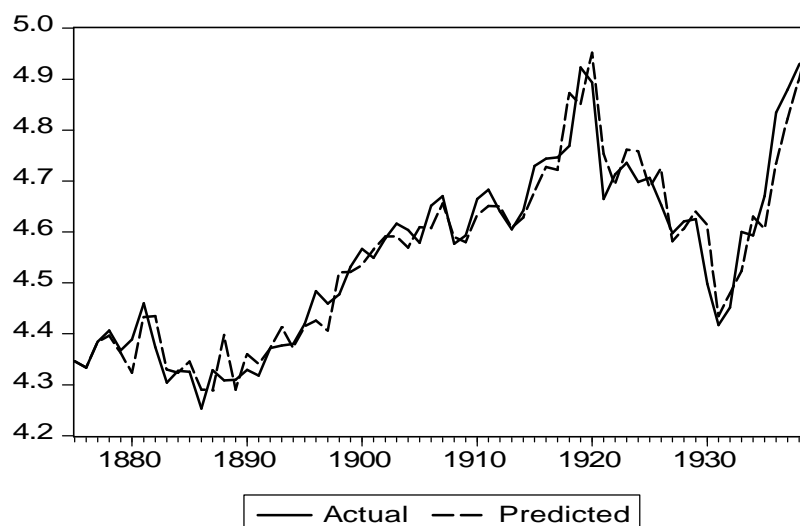
growth in the 1920s. Neither did farm productivity, although Condliffe's instincts of faltering farm productivity gains some support. The positive effects of rising numbers of cattle per capita were offset by lower sheep numbers per capita, and the overall effect is that lower "productivity" diminished slightly real GDP per capita. Lower real export prices had clear adverse effects, but the restoration of the public works programmes after World War I is associated with higher real GDP per capita. Money was essentially neutral over the years 1911/13-1927/29, its substantial effect was during the 1930s.⁶⁶ Overall, the collapse of rural land market transfer volumes is shown as the most potent depressing influence of the 1920s.

Table 7: Real GDP per capita and the long depression 1911/13-1927/29

	Actual 1911/13- 1927/29 (per cent per annum)	Long Run (LR) coefficients (from Table 6)	GDP per capita predicted by LR coefficient (per cent per annum)
Rural land transfers per capita	-3.12	0.34	-1.06
Real export price	-0.75	0.43	-0.32
Cattle per capita	1.16	0.77	0.89
Wage-rental ratio	1.70	1.05	1.78
Real land price	-2.23	0.62	-1.38
Real coins and notes per capita	-0.27	0.30	-0.08
Sheep per capita	-1.56	0.64	-0.99
Real public works per capita	2.19	0.08	0.18
Sources: as for Table 5.			

The overall predictions of the estimated cointegrating relationship and actual real GDP per capita are illustrated as Figure 3.

Figure 3
Log GDP per capita



It is possible to make use of additional information in the estimated VECM to shed further light on the key drivers of the long 1920s depression, by considering the statistical causality between the variables, and by gauging the relative force that innovations in each variable have within the multivariate system. The results illustrating the direction of Granger causality are reported in Table 8.⁶⁷ Two influences are shown to lead real GDP per capita, namely farm productivity as measured by cattle per capita, and rural land market activity indicated by the volume of transfers. In the context of the long depression, the results above in Table 7 show the net effect of these two variables reduced real GDP per capita by -0.17 per cent per annum between 1911/3-1927/29, a figure close to the actual negative growth.

A number of other features emerge from the causality results. The role of trade on real GDP per capita is shown to operate via other variables. Thus real export prices lead productivity (cattle per capita), the price of land (and the wage-rental ratio), and money, and therefore export prices are linked to real GDP per capita by their influence on farm productivity. Interestingly, in

the case of the two productivity measures cattle per capita leads, suggesting that the rise of dairying crowded out sheep. Condliffe's view that public works led land market activity gains support from the causality results, but public works also led real export prices pointing to investment in the transport infrastructure promoting New Zealand's overseas trade.

Finally, the relative force of individual component innovations in the vector auto regression (VAR) are shown in the variance decomposition results in Table 9. This decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting all the variables in the VAR.⁶⁸ Other than the impact of real GDP per capita innovations on itself, the two most powerful forces are shown as the volume of land transfers and the narrow measure of money. Money has powerful effect, but most of the variation in the money variable was in the 1930s, and we show elsewhere that the effect on real GDP per capita then was powerful.⁶⁹ Otherwise, the variance decomposition reinforces the finding that the volume of land market activity had powerful effects on New Zealand's real GDP per capita, and, in particular, on the long depression surrounding the 1920s.

Table 8: Granger Causality, Toda and Yamamoto, 1875 -1939

	Real GDP per capita	Rural land transfers per capita	Real price of exports	Cattle per capita	Nominal wage/ Nominal land price	Real Price of Land	Real notes and coins per capita	Sheep per capita	Real public works per capita
Real GDP per capita	-	<=	<≠>	<=	=>	<≠->	=>	=>	=>
Rural land transfers per capita		-	<≠>	<=	<≠>	<≠>	=>	<≠>	<=
Real price of exports			-	=>	=>	=>	=>	<≠>	<=
Cattle per capita				-	<≠>	<≠>	<≠>	=>	<≠>
Nominal wage/Nominal land price					-	< = >	<≠>	<≠>	<≠>
Real price of land						-	<≠>	<≠>	<≠>
Real notes and coins per capita							-	<≠>	=>
Sheep per capita								-	=>
Real public works per capita									-

Denotes unidirectional causality from variable in the rows to variable in the columns => ; <= Denotes unidirectional causality from variable in the column to variable in the rows; < = > denotes bidirectional causality; <≠> Denotes no causality identified.

Sources: Toda and Yamamoto, “Statistical inference”, otherwise as for Table 5.

Table 9: Variance decomposition: GDP per capita

Period	Real GDP per capita	Country transfers per capita	Real export price	Cattle per capita
2	89.90133	3.393338	1.663924	0.034170
5	68.05704	8.749442	1.252529	1.884413
10	61.71812	10.08896	1.609689	1.839798
Period	Real notes and coins per capita	Real land price	Wage-rental ratio	Sheep per capita
2	2.663620	0.266146	0.883255	0.861617
5	17.13314	0.195124	0.587506	0.694624
10	22.19274	0.142721	0.307076	0.375990
Period	Real public works per capita			
2	0.332594			
5	1.446181			
10	1.724905			

VI

Modern debates surrounding global commodity market integration have fostered renewed interest in the impact of staple exports on economic growth and income distribution. The case of New Zealand's pastoral export boom offers evidence favourable to the staple export-led intensive growth hypothesis. The Dominion's rural landscape was transformed by wider landownership and more intensive farming methods after refrigeration made possible the mass export of dairy products and frozen meat. Additionally, factor returns were augmented in manufacturing and services. In consequence, New Zealand had the highest GDP per capita, adjusted for purchasing power, in the world in 1938. The Dominion's staple export boom also set in motion forces of instability, which led to long swings in New Zealand economic growth and to a prolonged depression in the 1920s.

New Zealand's pastoral export boom did more than extend the Dominion's margin of cultivation; it substantially raised farm productivity and real GDP per capita. The contours of the New Zealand's economic development after 1890 were shaped by the idiosyncratic responses within the Dominion to the opportunities of international trade facilitated by refrigeration technology. Most especially, a rise in the social depth of land ownership accompanied the pastoral export boom, which set New Zealand apart from many other land abundant agricultural exporters of the periphery. Closer settlement underpinned a shift to more intensive farming methods in New Zealand. The statistical results show that the higher farm productivity made possible by closer settlement was a leading influence on real GDP per capita.

The productivity gains associated with staple exports spread beyond the farm sector. Rather than crowd out manufacturing, New Zealand's pastoral export boom increased factory-based employment. Pastoral product processing promoted a shift in New Zealand from handicraft to factory-based manufacturing, and was associated in meat freezing with a rise in corporate enterprise, and in dairying with co-operatives. The scale and the productivity of the freezing works rose sharply after 1890. Further, a distinctive New Zealand system of dairy products mass production which integrated the farm and the factory, and facilitated efficient marketing emerged.

The closer settlement of New Zealand led to higher farm productivity, but also heightened land market activity. The land market boom 1890-1920 was labelled by contemporaries as 'land-trafficking' with land sales frequently forming part of farmers' returns. Land market volatility was a powerful force for instability, given the rise in the social depth of landownership during the pastoral boom. A central theme in New Zealand's economic history highlights the vulnerability of the Dominion's economy to external shocks, particularly those connected to export prices. Our perspective differs, and emphasises that farmers' efficiency or revenue advantages were capitalized

into higher land prices. The statistical results show that the collapse of rural land transactions after 1920 led to prolonged depression.

New Zealand's economic development shows that export staples can provide a strong positive stimulus to intensive growth. What was distinctive about New Zealand was the extent that refrigeration-related staple exports promoted deep changes in economic organisation and efficiency that heightened economy-wide productivity. Not all staples have the capacity to stimulate economic transformation. The prospects for transforming the rural landscape, intensifying settlement, and raising farm productivity were modest when wool dominated New Zealand's staple exports before 1890. Refrigeration not only made possible higher land productivity but stimulated factory employment to process dairy and meat products, to benefit productivity further. In 1938 New Zealand was a remarkably prosperous economy. The decisions thereafter to promote broadly-based industrialization by insular protectionist policies can be linked to beliefs in the Dominion that staple exports were associated with instability, although contemporary diagnosis laid more stress on outside forces than on the effects of home grown land market volatility.

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² Chambers and Gordon, 'Primary products'.

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⁴ Baldwin, 'Patterns of development'.

⁵ Huff, 'Boom or bust'; Williamson, Land, labor'.

⁶ Schedvin, 'Staples and regions', p. 556.

⁷ Dowie, 'A century old'; Greasley and Oxley, 'Outside the club'.

⁸ Hawke, *The making of New Zealand*, p. 45.

⁹ Condliffe, *New Zealand in the making*; Crafts, 'The human development index'.

¹⁰ Critchell and Raymond, *Frozen meat*, and Philpott, *History of the New Zealand dairy*.

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- ¹¹ Bertola and Porcile, ‘Real wages and income distribution’, and Hawke ‘Adaptable Kiwis’, provide contrasts between Uruguay and New Zealand.
- ¹² Greasley and Oxley, ‘Growing apart’.
- ¹³ See also Figure 3 below.
- ¹⁴ Maddison, *World economy*.
- ¹⁵ Downie Stewart, ‘Land tenure’.
- ¹⁶ Gould, ‘The Occupation of farmland’.
- ¹⁷ Condliffe, *New Zealand in the making*, pp. 141-3.
- ¹⁸ *Statistics of farm production 1922*
- ¹⁹ Gould, ‘The twilight of the great estates’.
- ²⁰ Russell and Macklin, ‘Intensive dairying’, p. 22.
- ²¹ The implications of land market volatility for wider economic instability are considered in a later section.
- ²² The system is described in *Appendices to the journals of the House of Representatives*, 1871, section C.
- ²³ The workforce data are from Hawke, ‘Disaggregated’.
- ²⁴ *New Zealand official yearbook 1923*.
- ²⁵ *Statistics of farm production 1940*.
- ²⁶ Gould, ‘Pasture transformation’.
- ²⁷ *Statistics of farm production 1955*. A supplement to the report of this year shows historical data.
- ²⁸ Hawke, *The making of New Zealand*, p.86.

²⁹ Callaghan, *The course of land values in Canterbury*, Low, *Land prices and land valuation in New Zealand*. Full details of the construction of the new series may be found in Greasley and Oxley, 'Refrigeration and distribution'.

³⁰ The recording of land transfers was quickly established, with over 2000 transfers and 150,000 acres registered in 1874.

³¹ Russell and Macklin, 'Intensive dairying'.

³² Occupied area data are reported in *Statistics of New Zealand* for years to 1920, and *Statistics of farm production* thereafter.

³³ Mortgage rates are reported in New Zealand's *Official yearbooks*.

³⁴ Greasley and Oxley, 'Globalization and real wages'.

³⁵ Hawke, 'Disaggregation'.

³⁶ *New Zealand census 1867-1916* (quinquennial from 1881) included a factory production data appendix, and from 1918-19 annual *Statistical reports of factory production* were published in the Dominion. Hawke, 'Disaggregation', makes use of these data.

³⁷ *Statistical report of factory*, 1929

³⁸ Nesbitt Savage, 'A Long run' provides the deflator used here.

³⁹ *Statistical report of factory and building 1938-39*, p. 65

⁴⁰ *Ibid.* p.66.

⁴¹ *Statistical report of factory and buildings 1939-39*, p. 66.

⁴² Russell and Macklin, 'Intensive dairying', p. 24.

⁴³ *Ibid.* p 25.

⁴⁴ *Statistical report of factory*, 1928-9, p. 56.

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- ⁴⁵ Russell and Macklin, 'Intensive dairying', p. 25.
- ⁴⁶ Philpott, *A History of the New Zealand dairy*.
- ⁴⁷ *Statistics of factory production 1938-39*, p. 68.
- ⁴⁸ Russell and Macklin, 'Intensive dairying', p. 33. Wisconsin dairy farmers received a lower proportion of wholesale prices in the US market despite the shorter transport distances.
- ⁴⁹ Philpott, *A history of the dairy*, p. 147. The labour shortages of World War One encouraged machine-milking.
- ⁵⁰ The price premium realized by Danish butter on the London market disappeared by the 1920s.
- ⁵¹ Greasley and Oxley, 'Refrigeration and distribution', consider more fully the implications for the wage-rental ratio.
- ⁵² Blattman, Hwang and Williamson, 'The terms of trade'.
- ⁵³ Easton, *In stormy seas*, and Fleming, 'Agricultural support policies'.
- ⁵⁴ Belshaw, 'The economic position of the farmer', Condcliffe, *New Zealand in the making*.
- ⁵⁵ For example 50 dairy factories were opened in 1919-20, compared to 24 for the years 1923-38.
- ⁵⁶ Greasley and Oxley, 'Refrigeration and income'.
- ⁵⁷ Condcliffe, p. 268.
- ⁵⁸ Bloomfield, *Handbook of New Zealand*.
- ⁵⁹ Johnson, 'Postwar optimism'.
- ⁶⁰ Russell and Macklin, 'Intensive dairying'.
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- ⁶² Hussey and Philpott, 'Productivity and income'.
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⁶⁴ Greasley and Oxley, 'Globalization and real wages', consider the relation between GDP per capita and real wages in New Zealand.

⁶⁵ We consider elsewhere, Greasley and Oxley, 'Regime shift' how a new monetary regime promoted the 1930s recovery.

⁶⁶ For the details, see Greasley and Oxley, 'Regime shift'.

⁶⁷ The estimation method used to ascertain the direction of causality follows Toda and Yamamoto, 'Statistical inference'.

⁶⁸ The particular factorisation used to orthogonalize the innovations here is Cholesky. Although there is some sensitivity to the ordering of the variables in the VAR, the qualitative results presented remain unchanged.